UNIVERSITY OF JOHANNESBURG

PROGRAM : BACHELOR OF ENGINEERING TECHNOLOGY [**BEng Tech**] IN ELECTRICAL ENGINEERING. B6ELEQ & B6ELXQ

MODULE : **ELECTROTECHNOLOGY 1B**

CODE : **ELTELB1**

DATE : SUMMER **SUPPLEMENTARY** EXAMINATION JANUARY 2020

DURATION : 3 HOURS

CALCULATION CRITERIA : 40 [SEMESTER]: 60 [EXAM]

NQF : 5

TOTAL MARKS :100

EXAMINER : Ms E.F. SWANA

MODERATOR : PROF. P. BOKORO

NUMBER OF PAGES : 5 PAGES

INSTRUCTIONS : QUESTION PAPERS MUST BE HANDED IN.

REQUIREMENTS : 2 SHEETS OF LINEAR GRAPH PAPER.

INSTRUCTIONS TO CANDIDATES:

1. 100 MARKS = 100%.
2. ATTEMPT ALL QUESTIONS.
3. ANSWER QUESTIONS CONSIDERING THE MARK ALLOCATION.
4. QUESTIONS MAY NOT BE ANSWERED IN ANY ORDER AND **ALL PARTS OF A QUESTION MUST BE KEPT TOGETHER**.
5. ALL DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY AND LABELED CLEARLY.
6. ALL WORK DONE IN PENCIL EXCEPT DIAGRAMS AND SKETCHES WILL BE CONSIDERED AS ROUGH WORK.
7. **MARKS WILL BE DEDUCTED** FOR WORK WHICH IS POORLY PRESENTED.
8. ANSWER ALL THE QUESTIONS.

QUESTION 1

For the network shown in Figure 1, find Norton equivalent network. When a 6 Ω resistance is connected between A and B. Determine the current flowing in the 6 Ω resistance by using Norton equivalent circuit. (10)

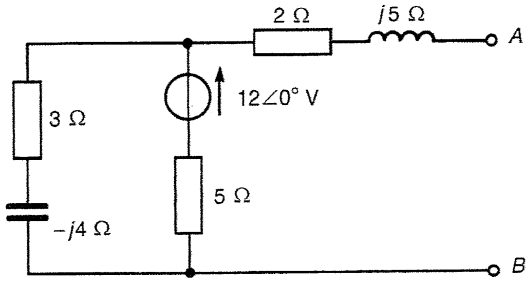

Figure 1: Network for question 1

[10]

QUESTION 2

For the network shown in Figure 2, apply Nodal analysis and assume all currents are leaving the node to determine:

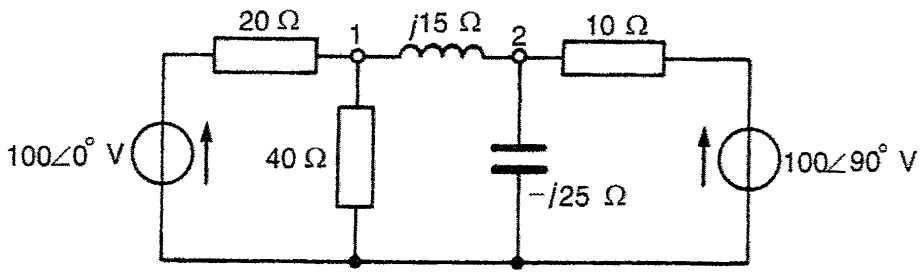

Figure 2: Network for question 2

2.1 The voltages at nodes 1 and 2. (15)

2.2 The current in the 40 Ω resistance. (2)

2.3 The current in the 20 Ω resistance. (2)

[19]

QUESTION 3

A 400kVA transformer is operating at full load with an overall power factor of 0.75 lagging. The power factor can be improved by adding capacitors in parallel with the transformer until the overall power factor becomes 0.90 lagging. Determine the rating (in kilovars) of the capacitors required. (12)

[12]

QUESTION 4

In the circuit given in Figure 3, Find the real and reactive powers absorbed by the line and the load. (15)

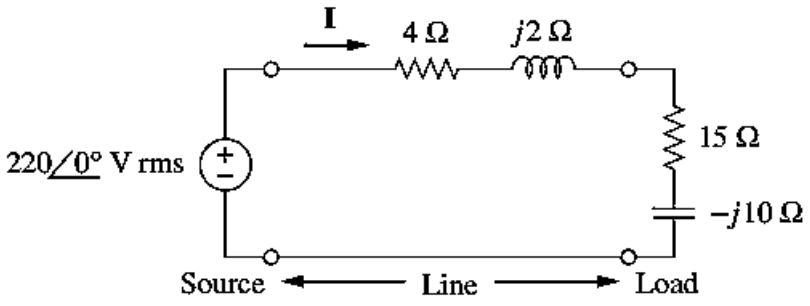

Figure 3: Network for question 4

[15]

QUESTION 5

An 800 kW induction furnace at 0.88 power factor operates 20 hours per day for 26 days a month. Determine the electricity bill per month based on the tariff structure:

Energy Charge: 15 cents per kWh

Power Factor penalty: 0.8 % of energy charge for every 0.01 that pf falls below 0.85

Power Factor credit: 0.8 % of energy charge for every 0.01 that exceeds 0.85 (12)

[12]

QUESTION 6

A ferromagnetic-cored coil is in two sections. One section has an inductance of 750 mH and the other an inductance of 148 mH. If the coefficient of coupling is 0.6, calculate:

6.1 The mutual inductance of the coils. (2)

6.2 The total inductance when the sections are connected in series aiding. (2)

6.3 The total inductance when the sections are in series opposing. (2)

[6]

QUESTION 7

Determine the value of voltage E_2 which appears across the open-circuited secondary winding of Figure 4. (6)

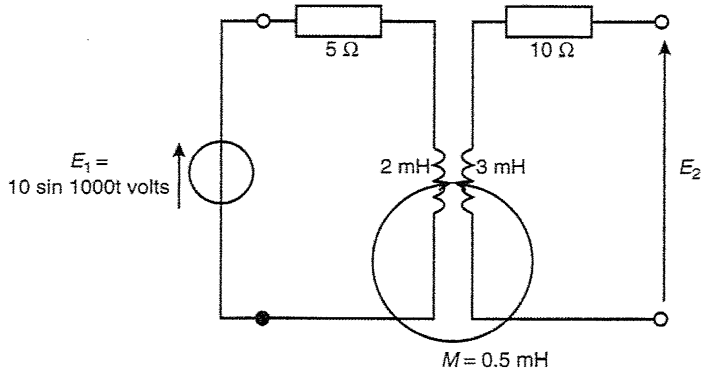

Figure 4: Network for question 7

[6]

QUESTION 8

A generator has an output impedance of $(300 + j45)\ \Omega$. Determine the turns ratio (N_2/N_1) of an ideal transformer necessary to match the generator to a load of $37 + j19\ \Omega$ for maximum power transfer. (6)

[10]

QUESTION 9

Three identical coils, each of resistance 20 Ω and inductance 72 mH are connected in delta to a 415 V, 50 Hz, three-phase supply. Determine the total power dissipated in the coils. (9)

[9]

QUESTION 10

10.1 Two wattmeters are connected to measure the input power to a balanced three-phase load. If the wattmeter readings are 9.3 kW and 5.4 kW, determine the total output power and the load power factor. (6)

10.2 An 8 kW is found by the two-wattmeter method to be the power input to a three-phase motor. Determine the reading of each wattmeter if the power factor of the system is 0.85. (6)

[12]

TOTAL : 100